Carbon A List

Insight into innovations to close the carbon cycle

Posts

Ready, set, go! Restoring the Carbon Balance is possible it just needs more ____

May 12, 2017

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Climate change is real and it is caused from excess carbon dioxide that humans put in the atmosphere. Fact. This April, the Carbon Brief reported that we are on a pathway to blow our carbon budget in about 4 years. And in March 2016 we were on track to blow the carbon budget in 5 years. So from a year's worth of work, we bought ourselves a month. Comforting, eh?

For anyone who is concerned about the rationale, methods and strategies to not overshoot the amount of carbon dioxide that ends up in the atmosphere, the three-part series of hour and a half webinars "***Restoring the Carbon Balance***" hosted by the Security and Sustainability Forum is a great place for expert insight. It was split up into three sessions.

1. The Budget Imperative, Moderated by David Biello (TED), Jeff Sachs (United Nations Adviser), John Sheppard, (Emeritus Professor of Earth System Science within the Ocean and Earth Science department of the Faculty of Natural and Environmental Science, University of Southampton, at the National Oceanography Centre Southampton and a Fellow of the Royal Society), and Kevin Anderson (Professor of Energy and Climate Change in the School of Mechanical, Aeronautical and Civil Engineering at the University of Manchester)
2. The Technologies Moderated by Joel Makower (GreenBiz), with Klaus Lackner (Center for Negative Carbon Emissions, ASU), Susan Hovorka (Bureau of Economic Geology, UT Austin), and Eric Larson (Andlinger Center for Energy and the Environment, Princeton)
3. Policies and Financing, Moderated by Andy Revkin (Propublica), Klaus Lackner (Center for Negative Carbon Emissions, ASU), Fatima Ahmed (Center for Climate and Energy Solutions), and Richard Mattison (Trucost)

These webinars are a valuable resource and provide an up-to-date perspective on both the state of negative emission technologies as well as supporting or bridge technologies that can enable them, such as distributed energy resources, synthetic hydrocarbons, and industrial carbon capture. There are many nuances and distinctions that are relevant to the negative emissions technologies discussion. So if you have time, and are interested, do listen. Don't have almost 5 + hours on your hands to nerd out about this stuff? No worries! Here are my six takeaways (sprinkled with commentary):

Treating climate change like a waste management issue could change the game

This idea rang loud and clear on the webinars. And for good reason because the brains behind this three-part series is physicist Klaus Lackner of the Center for Negative Carbon Emissions who has been promoting this way of thinking for some time. I'm fortunate to have worked for Lackner from 2013-2016, and he can take a lot of credit for my perspective on sustainable energy systems and carbon management. These concepts are expanded upon in an article that he and I published this Spring in *Issues in Science and Technology:* "Climate Change is a Waste Management Problem." The logic is as follows:

- Carbon dioxide (CO_2) accumulates in the atmosphere and stays there for centuries
- Excess CO_2 that humans dump into the atmosphere exacerbates the effects of climate change
- You wouldn't like it if I only dumped less trash openly in the street (i.e. emissions reductions only) or if I stopped dumping (i.e. switching to carbon free energy) but my neighbor still did it
- If we thought about the global atmospheric build up as a waste issue then it would be more feasible to create a policy framework that gets to zero
- Therefore safe and permanent methods that can store carbon of past, present and future are critical
- Bottom line: for every ton of CO_2 we emit, another one must be put away. Putting it away sets the marginal cost on carbon. This can motivate the need to reduce emissions, reuse the waste, and recycle carbon that is already in the atmosphere

Of course, this is a top down approach that wouldn't happen over night. It would most definitely work with universal prices on carbon and other ideas which bi-partisan economists agree to be a good thing. What it really changes is the mindset. If I tell you that you have to clean up after yourself, and that requires putting carbon back, then you  can no longer discounts the irrational harm that you are causing to future generations. Right now, the Intended Nationally Determined Contributions only look out to 2030, so we kick the hardest challenges down the road. The point here is that saying that we have to remove carbon back out of the atmosphere doesn't delay action on all the other create mitigation options; it actually motivates them. Restoring the carbon balance from the waste management perspective therefore ultimately requires a close look at the various fluxes (red arrows) and sinks (blue arrows) and finding ways to safely and permanently keep it on a sustainable keel.

Volunteers can drive down the cost of new solutions

The waste management paradigm is top down and needs to work on a global level. This would require all sorts of coordination and action between the powers that be who are behind the Conference of the Parties Paris accord. However, this can also start from responsible citizens and corporations who want to support new innovations that can restore the carbon balance. Early adopters can play a role in creating a push for paying for applications that create a carbon sink. There already is a sizable demand in voluntary carbon offset markets. However, only a few of these options are truly negative emissions in the sense that the take CO_2 that was previously in the atmosphere and store it. If you're paying for a tree to be planted somewhere, does it really count if we are cutting down more trees elsewhere at a greater rate? Volunteers need to think about issues such as:

- How much does it scale?
- How quickly can it pull back carbon dioxide (or stop it from going to the atmosphere)?
- Where does and doesn't it work?
- Where does it get the carbon dioxide? (from an emission source – less expensive, and important because it stops the carbon from reaching the atmosphere – or directly from the air – more expensive, but ultimately necessary to enable a carbon neutral or carbon negative option)

- What additional benefits or synergies might this enable?
- What damages or risks might this technology incur?
- How much cheaper can it get as a function of paying for it today to get started?

It is critical, however, that volunteers who are supportive of new ideas are not hoodwinked by a greenwash. Green labeling has successfully commanded a price premium in many markets. Sometimes it's legitimate, sometimes it is not. Most consumers don't take the time to truly understand the difference.

At the end of the day, the world needs to foot the collective research bill

Solving climate change won't come free, but the making the investment now will generate returns well beyond what we will pay for business as usual. Along with individual volunteers who can drive demand for negative emissions, corporations, wealthy angel philanthropists, and governments need to foot the bill. Today. There is a $44 trillion price tag between now and 2050 to fund the gamut of systems that can decarbonize the energy infrastructure to where it needs to be. However, there is more capital is going to options that only delay climate change or generates a quick return, with a pittance going to options that could ultimately reverse it. Delaying innovation that can get us out of the mess we caused is not an option. With funding cuts to science on the horizon, this is truer than ever. As part of the 44 trillion, there needs to be funding for good ideas that don't have immediate payback, but are indeed long term cures. One of the ideas that surfaced in the webinars was to look for parallels in the pharmaceutical industry which advances certain "miracle" drugs over a long time period, does substantial government testing, and then releases them. This would require collective action, collaboration, and leaving Napoleonic egos at the door, but it's possible. The Center for Carbon Removal published a report "Philanthropy Beyond Carbon Neutral" which provides excellent framing for the role that philanthropists can play to accelerate the options available.

There is no one silver bullet but there ***are*** many silver buckshot

There is no one magic button technology that will solve all the world's climate problems. It takes a holistic view of all the decarbonization required. The Breakthrough Energy Coalition has pulled together a comprehensive report of silver buckshot options for deep decarbonization.

All
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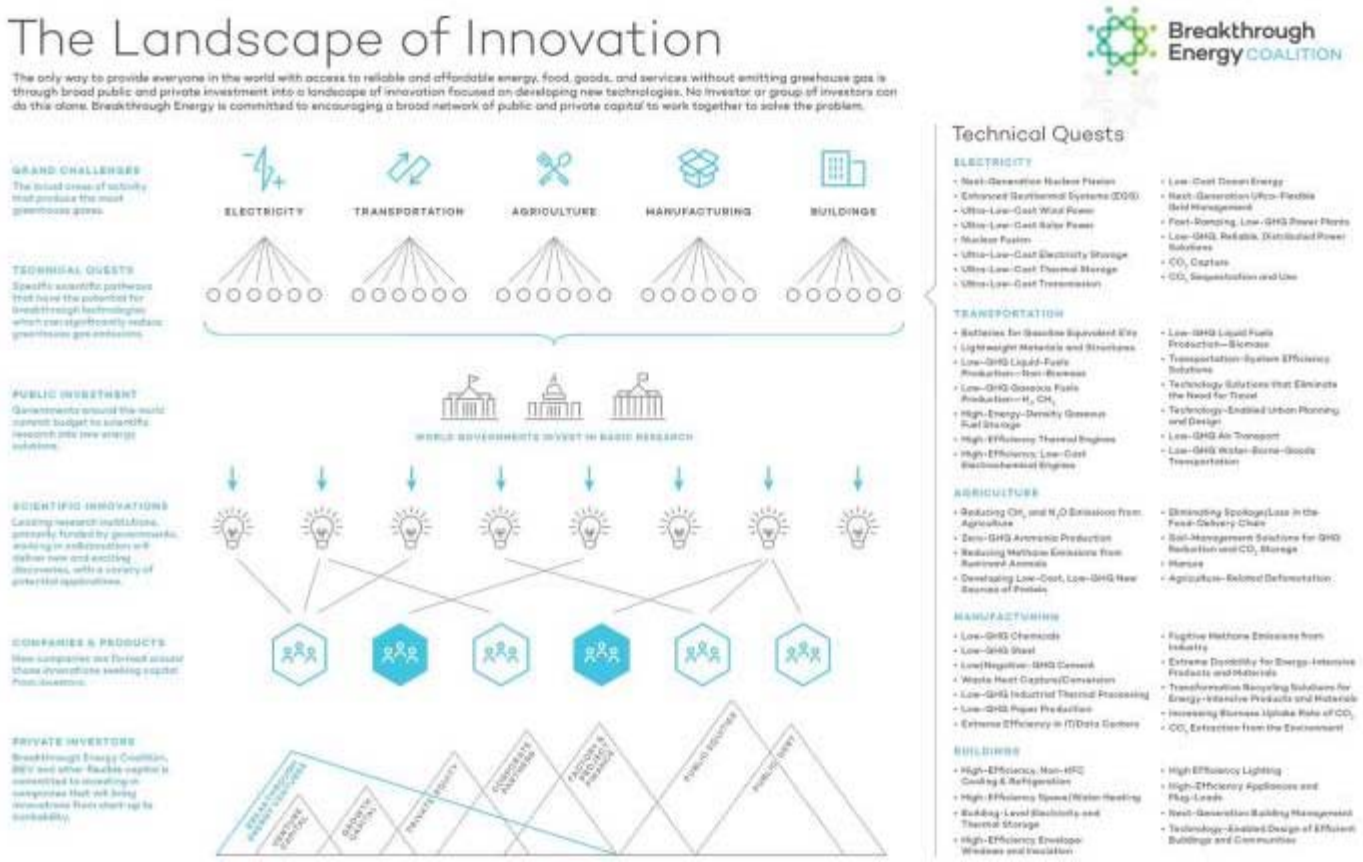

these options are critical and are great as options to be motivated in the waste disposal paradigm. Mandating removal means that you look for options to reduce, reuse, recycle – and not need to dispose of it in the first place!

For carbon removal, more silver buckshot need to be advanced and articulated. Different approaches will work well in different geographic settings. For instance, certain direct air capture applications work well in dry regions. Others require an inexpensive source of heat that is most readily available from waste processes. Bioenergy with carbon capture and storage is effective in some places where large swaths of biomass can be quickly grown, but when it upsets natural biomass that is happily already sequestering carbon it can be detrimental. Other carbon removal options, which include biochar, enhanced weathering, cloud treatment, biomass, soil carbon, ocean capture, blue carbon, and afforestation all work and are worthy of more testing and scaling. They all have their nuances and work well in different regions. Here's a nice explainer put together by the Carbon Brief wrote with more details on the options.

Incremental change is important and can be done through market based solutions and quick wins to prove feasibility

I love breakthrough innovation. It's what I like to amplify in my newsletter (I write about market based solutions that can capture, use, reduce, store, carbon or not put it there in the first place). However, "quick" wins and incremental change are equally important. From the carbon management perspective, this means this means putting forth options to society that have immediate paybacks, a market value, and a path to scale – whether that means doing more of it or bringing down the cost. Quick wins for the carbon space include options which:

- Address a market need and enables a pathway to being able to capture or permanently store carbon.
- Don't break the bank
- Are unambiguous in the carbon accounting
- Integrate into the broader sustainability framework
- Are modular
- Ideally can automate

I like the last two points because modular technologies are easier to replace and improve and have a lower capital cost. That means they lend well to being mass manufactured and coming down in cost more quickly than a centralized power plant that is in place for 40 to 50 years. If you are rolling out a new technology or solution and want to survive in 2017 at all in the future, you need to be able to automate and plug into the internet of things. If not, you're in the stone ages.

The way in which the carbon capture, utilization and storage (CCUS) industry plays its hand really, really matters

This is a tricky one. I've blogged about this before (We can't rely on carbon capture and storage to make a dent in solving climate change without a carbon removal hook). The CCUS community has a critical role to play in restoring the carbon balance. The underlying technology to capture CO_2 from centralized emissions works, and there are indeed some real breakthroughs happening in the space that will allow for more efficient capture, transformative conversion, and cost effective and scalable storage.

> *However, the problem with carbon capture is that it fundamentally isn't restoring the carbon balance.*

For CCUS to work, it needs to extract more carbon from the ground just to put it back again. And since capturing carbon costs money, it needs clear policies in place to justify the capital expenditure along with ways to defray the cost of capture. Also, it needs to think about where to put the carbon. A typical gigawatt coal fired power plant emits around 20,000 tons of carbon dioxide per day. If we're talking about not putting it there in the first place, it needs to find a massive sink – either to store it, or for some valuable use. Not all storage sites are created equal, nor are publicly acceptable, which means that just because a technology will work in one area, that it won't necessarily work somewhere else.

On the one hand, it could be entirely possible to leverage
the CCUS research to have a credible pathway to

Petra Nova Facility capturing 90% of the carbon for enhanced oil recovery

permanent storage and ultimately negative emissions. Large scale centralized plants could begin using biomass in some locations and then storing that to create negative emissions. Methods to convert or store carbon could begin to look to industrial sources that extract it – like air capture – to improve the carbon balance. There are plenty of thoughtful career engineers who are acutely aware of the climate science and are advancing important and meaningful work. They produce road maps for carbon utilization for deep decarbonization pathways and inform thoughtful models that consider more than just emissions from electricity sources. Some of these companies or solutions are concepts that I write about in the Carbon A List newsletter. They understand the portfolio of solutions and are aware that CCUS wont work everywhere, and consider ways to synergize with the renewable energy revolution. These are the good guys.

<soapbox>

On the other hand, carbon capture could become a red herring that is used to only talk about – but never actually build at scale – a future solution that can stop fossil fuel emissions. Worse the analysis from the “good guys” to could be used to justify the continued and accelerated extraction of all types of fossil fuels. Until. The. End. Of. Time. And even worse, patent portfolios that could make a breakthrough difference in restoring the carbon balance can be bought up for no other reason than to stop its advancement as an excuse or mandate of “best available technologies” that now the companies must do something. This attitude and approach will lock the world into infrastructures that do not care about the carbon balance, but certainly will make a lot of money in niche industries that can make use of carbon for high value products under the guise of green-washing and under-reporting on emissions. The uninformed “Clean Coal” supporter might be in this camp. They may not believe in or care about climate change. These are the remnants of the meetings that happened behind closed doors and come out with strong lobbying efforts that delay real action.

> *Imagine a group of crusty old white men who will always consider resources in the ground as valuable and will fight any notion of assigning its extraction an externality.*

Yeah, those guys. Their influence still permeates decision-making at companies, affects policies, and is responsible for a lot of the negative perception of the CCUS industry. Blame them because they’re really screwing this whole restoring the carbon balance effort up.

</soapbox>

In Conclusion...

I'll leave you with a scenario in the climate change chess game that perhaps fits into what is presented in the "Restoring the Carbon Balance" series. Actors call it "Yes And." It's where there is no one right answer, but there is a great synergy when everyone works together and builds upon the group. A collective awakening results in the realization that for every ton of CO2 we emit, another one of the past, present or future must be put away. That means we start from a target of zero. The circular carbon economy actually becomes a thing. We begin to enjoy the great amount of cost savings we get from efficiency, conservation, and electrification. Fossil emissions use CCUS efficiently and responsibly, but over time gets phased out by the low cost renewable sources of energy who have balanced their load with effective storage and synthetic fuels. All carbon from centralized sources is captured, and anything that uses additional carbon gets it via biomass or direct air capture. Carbon is stored in our stuff, in depleted reservoirs, in minerals. Agriculture becomes more sustainable with a carbon balance in mind. Water is not a problem because we've figured out a low cost way to filter it or grab it from air. We plant trees to replace the ones we cut down. And more renewables pop up at old mines (like this one in Germany) which start to carbonate the tailings with technologies that can remove carbon. And other great negative emissions ideas become available for different geographic regions so our children have the tools to clean up for the mess we left them. Like a self replicating machine that grows in barren regions and stores carbon.

Kumbaya.

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